Aerial Photography Densitometric Evaluation System

Version 3.0

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Resource Information Branch

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1.0 Introduction

The aerial photography evaluation system is written to address the problem of quantifying and archiving photographic deficiencies found in the aerial photographic negatives. The quantitative densitometric data which the system generates provides a good benchmark by which the quality of the photography can be judged. The structured format of the evaluative procedure also aides in achieving consistency and objectivity in the final determination of the pass or fail criteria of a given film roll.

The evaluative criteria by which the aerial photography is judged is based on the federal Interdepartmental Committee for Aerial Surveys specifications, 1982 edition. The cornerstone items are specifications #26 and #27. These two sections of the specifications refer to the status of exposure and contrast respectively. Based on the measurements made throughout a roll or job the two specifications determine the photographic status of the negatives.

The quality control evalutative system simply records the data, keeps it organized, and applies the two specification items to the data recorded. The software also files the information derived and provides a monitoring routine which can be used to view the quality status of a particular contractor.

The fine details of what is required from the contractor in terms of calibration reports, flight data reports, stepwedges etc. will all be identified as they apply to the

various components of the software.

2.0 Operating System

The software system operates in a DOS environment. A version of DOS 3.0 or higher is recommended to run not only the program but also a module which provides the windowing effect used extensively throughout the program. A batch file named QC.BAT contains the executable code and the windowing module. The file QC1.BAS contains the code orginally written in Quickbasic. The program is activated by typing QC at the DOS prompt.

3.0 Getting Started.

Before the program is actually run a few basic checks should be performed.

- Ensure the densitometer is calibrated and zeroed, the calibration check does not need to be done too often, but the zeroing should be done before every session.
- Ensure that you have the aerial photography flight report with the roll of negative originals. Information such as scale, number of frames exposed, shutterspeed, and airspeed are necessary information variables required by the program.
- Check that the aerial photography company has supplied

a) a stepwedge exposed on the roll with the negatives and,

b) a densitometric plot of the stepwedge with all the pertinent details supplied. A sample of this densitometric

plotting sheet is attached[1].

Also required is a calibration report of the aerial photography company's sensitometer. These calibration values are necessary if you intend on checking the average gradient values as have been reported by the contractor on the densitometric plotting form. A sample of this calibration report is also attached[2]. The Log Exposure values as indicated on this report are placed in the program only once, therefore this exercise is performed only whenever photography from new contractors is obtained. The input routine for this data will be covered in later section.

4.0 Beginning the Program

Type QC to start the program. A menu for various functions appears on screen.

```
AERIAL PHOTOGRAPHY
CONTRACTOR Q.C. PROGRAM
**Alberta Government**

1) Quality Control Film
   Evaluation

2) Communication settings

3) Contractor statistics

4) Update calibration

5) End session

6) General information
   on this program

7) Quality Control Print
   and Diap Evaluation
```

```
This item begins the
Q.C. Evaluation program.

Press ENTER or RETURN
for the next step.
```

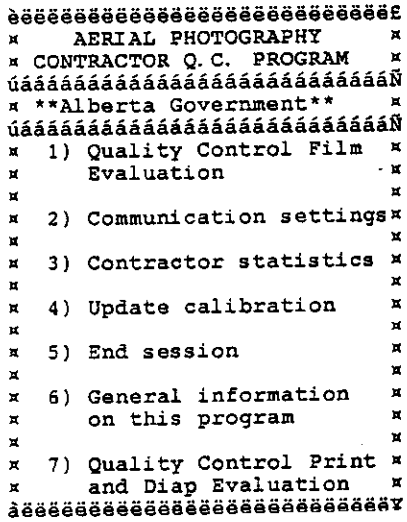
[1] See Appendix 'A'
[2] See Appendix 'B'

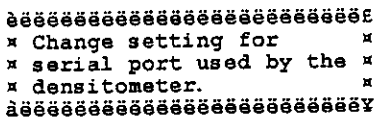
From this menu a number of options are possible, from running the main program which does the aerial photography evaluative function (choice #1) to other functions which are primarly intended to set up the system for customized use.

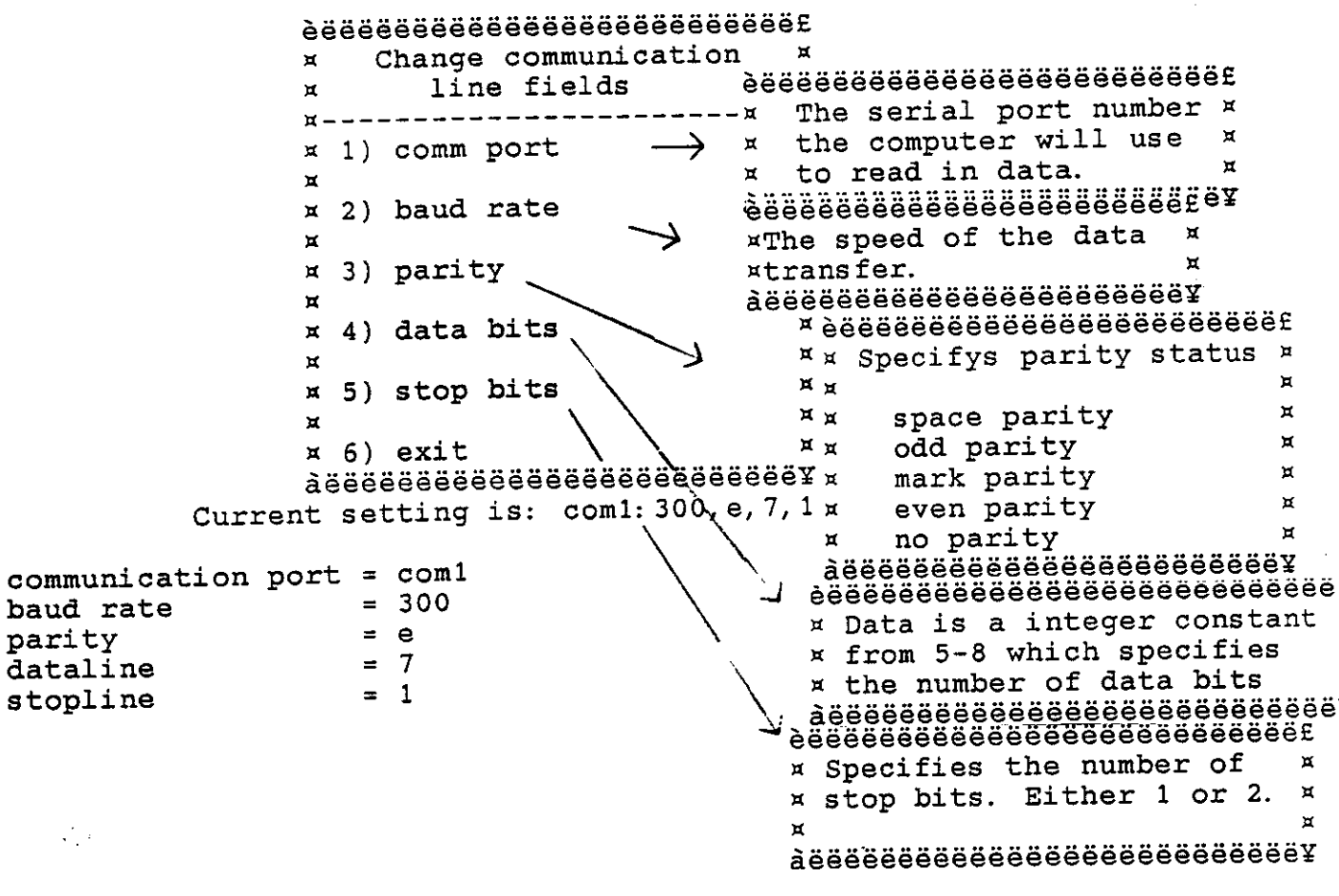
5.0 Configuring the program.

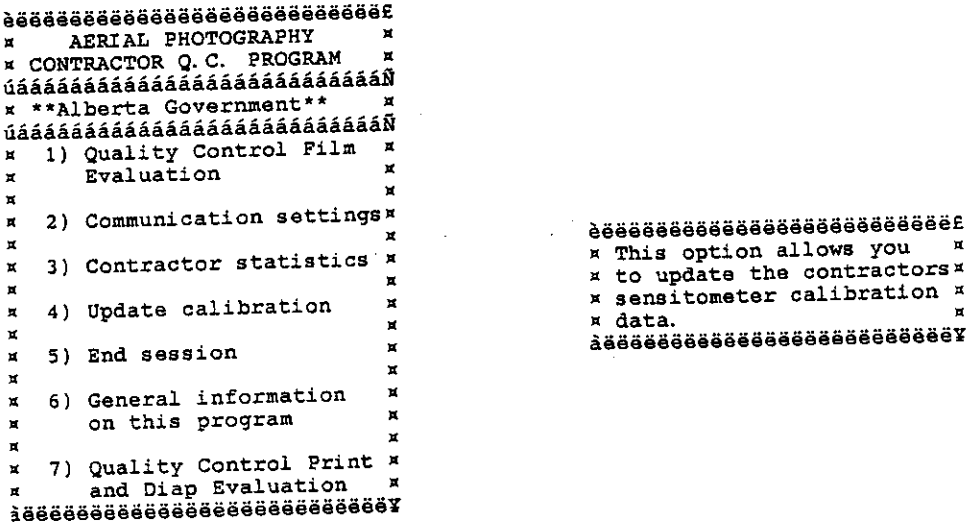
Before production analysis can begin a number of system variables must be set. These variables can be set by choosing item #2 (Communication Settings) on the main menu. The menu choices can be obtained by typing the number desired or by moving the cursor to the menu item, in either case the ENTER key is pressed for program acceptance.

After choosing item #2 a communication parameters menu appears. From this menu the communication variables are set. The following figures display all the screens available.






Change communication line fields
1) comm port
2) baud rate
3) parity
4) data bits
5) stop bits
6) exit
The serial port number the computer will use to read in data.
The speed of the data transfer.
Specifys parity status
space parity
odd parity
mark parity
even parity
no parity
Data is a integer constant from 5-8 which specifies the number of data bits
Specifies the number of stop bits. Either 1 or 2.
Current setting is: com1:300,e,7,1
communication port = com1
baud rate = 300
parity = e
dataline = 7
stopline = 1



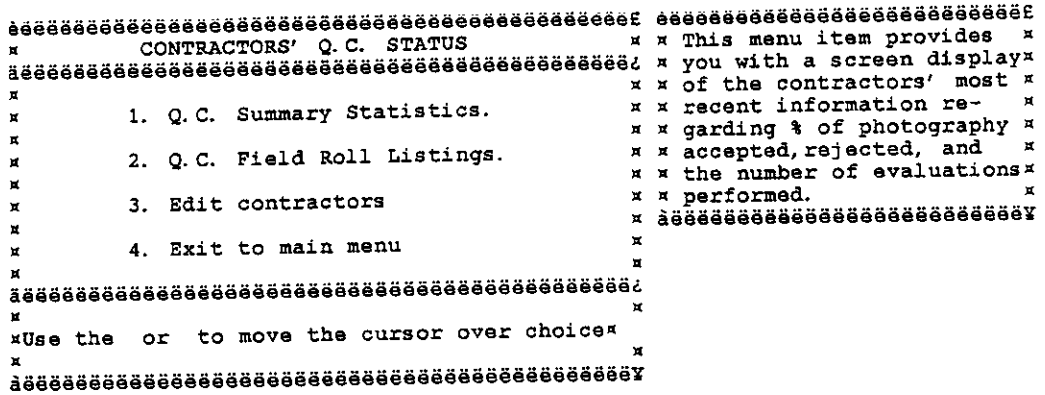
Proper configuration of these parameters depends on the individual system being set up; however, there are some variables which either don't change or for which the choices are limited:

- com port: 1 or 2
- baud rate: 300 or 1200
- parity: even
- data bits: 7
- stop bits: 1

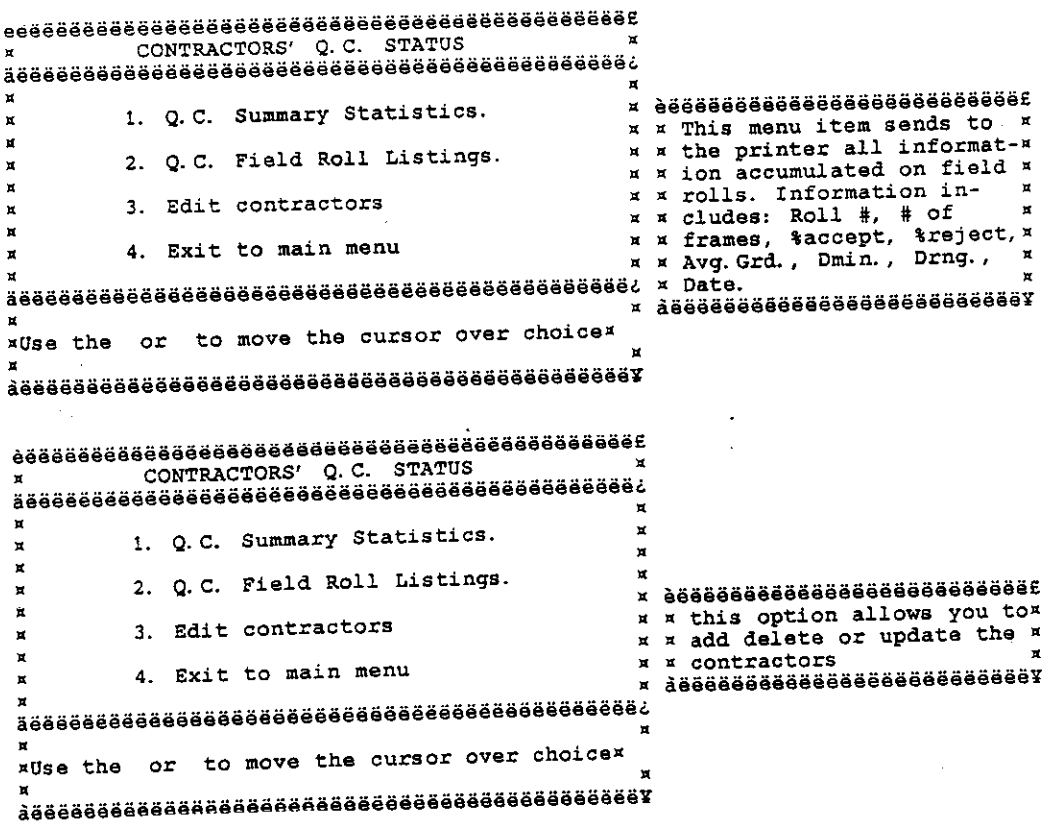
The menu screen displays the choices you have made below the window display. Once these parameters are set for a given system they do not need to be altered again, unless a serial port is changed or the densitometer's memory is erased.

6.0 Contractor Statistics.

This is option is obtained by choosing item #3 on the main menu. Once chosen the following screen is displayed:

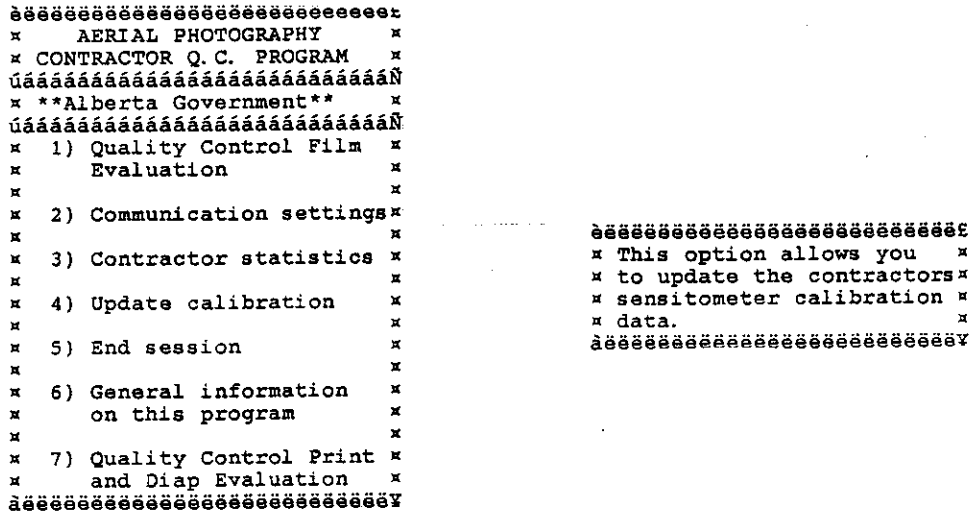


Item #1 on this menu provides a screen display of the current quality status for the contractor chosen. Item #2 of this menu enables you to obtain a printout of the field roll data of the contractor chosen. Item #3 provides easy editing facilities to add, delete, or modify the names of aerial photography contractors. The following figure displays this screen.



7.0 Update Calibration.

This menu choice is obtained by choosing item #4 on the main menu. A choice of desired contractors is initially displayed followed by a screen display of either no sensitometric data (empty file) or the last update of the sensitometer calibration data. If this information requires insertion (for a new contractor) or an update, ensure that you have the contractor's sensitometric calibration sheet. The screen for this information is as follows:



8.0 Quality Control Evaluation.

Item #1 on the main menu initiates the quality control evaluation program. Before starting this program ensure that the contractor who you are evaluting is entered in the Contractors' Statistics program (item #3 on the main menu) and that the calibration information is entered in the Update

Calibration program (item #4 on the main program).

The program initially displays a menu of the current contractors:

```
Please choose the contractor for the job

    èëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë£
    ¤ALBERTA GOVERNMENT
    ¤GEODESY REMOTE SENSING
    ¤GLOBAL REMOTE SENSING
    ¤PRISMA
    ¤FOTO FLIGHT
    ¤NORTHWEST GEOMATIC
    ¤GEOGRAPHIC AIR SURVEY
    àëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥
```

Choose the appropriate aerial photography company.

The program then displays a screen requiring some base information:

```
                     GENERAL INFORMATION
                     -------------------

Contractor            : ALBERTA GOVERNMENT
FIELD JOB NUMBER      :


  eeëëëëëëeeeeeeeeëëëëëëëëëëëëëëëëëëë£
  ¤           ENTER IN THE           ¤
  ¤                                  ¤
  ¤            FIELDTYPE             ¤
  àëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥
```

Type in the field roll number or your assigned job number; this information is simply an identifier for the Q.C. data.

A film type menu is displayed next, enter the type of emulsion you are evaluting (pan or I.R.).

GENERAL INFORMATION

Contractor : ALBERTA GOVERNMENT
FIELD JOB NUMBER :

FILM TYPE
1. Panchromatic
2. Infrared

You are prompted next for the film brand, enter the film that was used for the job:

Panchromatic emulsions	
1. Kodak Double-X	2405
2. Kodak Plus-X	2402
3. Kodak Panatomic-X	2412
4. Agfa Aviphot Pan	200
5. Agfa Aviphot Pan	150
6. Agfa Aviphot Pan	50
7. ILFORD HP5	
8. ILFORD FP3	

The following screen initiates a routine to calculate image motion on the negative. The Interdepartmental Committee on Aerial Surveys specification #11 requires that image motion on the negative be kept to below 20 micrometers. The routine displayed is a check for this criteria.

```
┌──────────────────────────────────────────────────────────────┐
│                    Image Motion Analysis                     │
│  I.C.A.S specification item #11 requires image motion to     │
│  be kept below 20 micromteters. Some cameras compensate for  │
│  the FORWARD motion axis and do not require this analysis.   │
│                                                              │
│         DO YOU WANT TO PROCEED WITH THIS ANALYSIS?           │
│                                                              │
│                          YES                                 │
│                          NO                                  │
└──────────────────────────────────────────────────────────────┘
```

Camera systems which have image motion compensation should not be subjected to this check. For those systems which are not equipped with FMC a number of variables are needed for this check: aircraft speed, shutter speed, and scale. These items are standard reporting parameters on flight reports (the aircraft speed may have to requested to be placed on the flight report). The following screen display outlines how the values are entered into the program:

```
Enter the average speed of the aircraft (in knots)? 150
Enter the slowest shutterspeed used (eg : 200)? 300
Enter the scale of the photography (eg : 1000)? 20000
```

Once the variables are entered the next screen display displays the calculated image motion, and, whether or not it has passed I.C.A.S. spec #11:

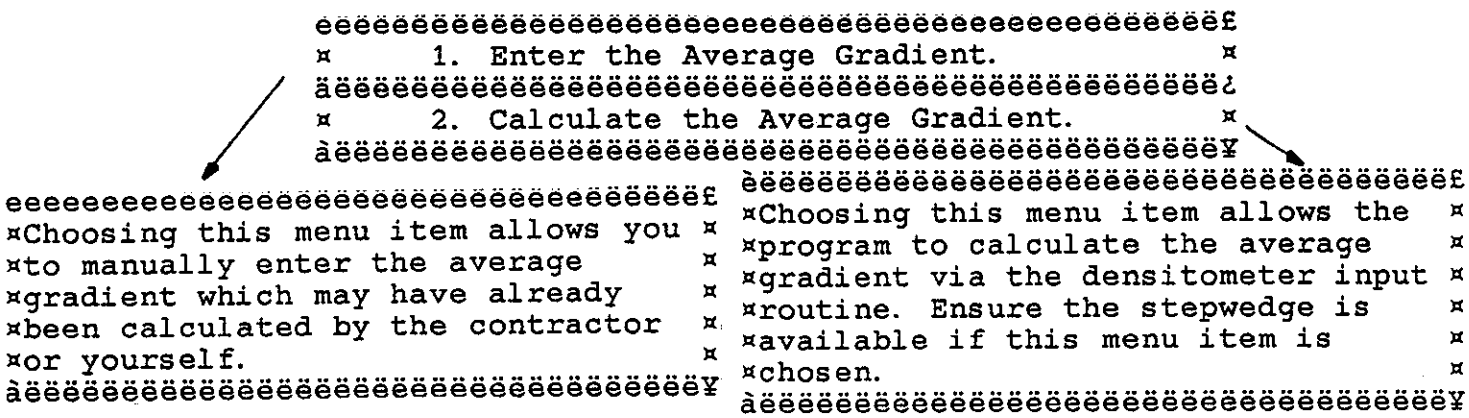
```
Enter the average speed of the aircraft (in knots)? 150
Enter the slowest shutterspeed used (eg : 200)? 300
Enter the scale of the photography (eg : 1000)? 20000

Image motion has been calculated to be :  12.9
I.C.A.S Specification item #11 is ACCEPTED

press any key to continue?
```

The next screen which is displayed pertains to the status of processing the negatives; the variable defining this condition is called the average gradient. The menu choices are twofold: enter a predetermined average gradient or calculate the average gradient.

```
1. Enter the Average Gradient.
2. Calculate the Average Gradient.
```



If the manual entering of the average gradient is chosen then the densitometric report from the contractor is necessary to obtain the reported average gradient. The screen entry format is shown below:

Average Gradient : 1.15

ENTER IN THE

AVERAGE GRADIENT

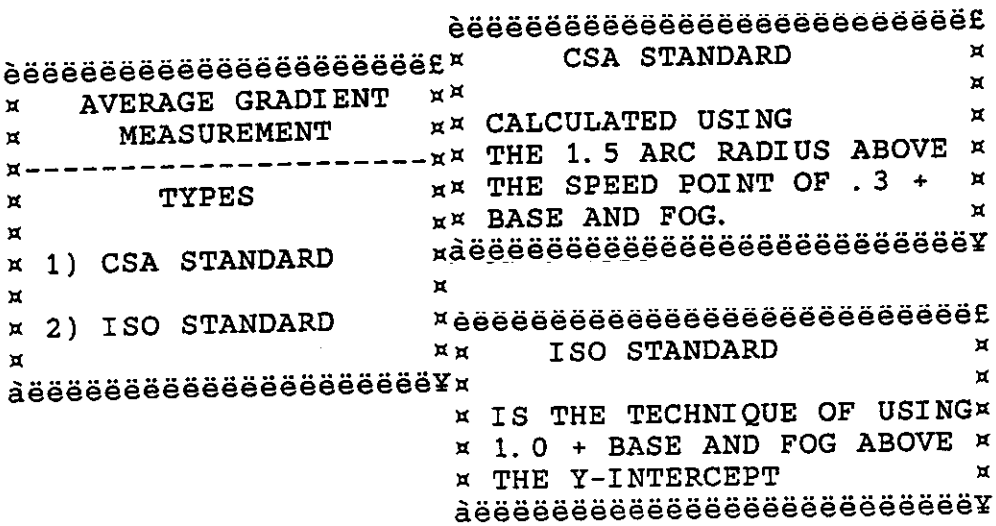
Once the average gradient is entered a prompt for the Base and fog appears:

```
ÚÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¿
³        ENTER IN THE         ³
³        BASE AND FOG         ³
³   USING THE DENSITOMETER    ³
ÀÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÙ
```

Use the densitometer to measure and enter the base and fog as portrayed by any clear area of the roll being evaluated (this can be at the beginning of a roll or in between the exposed frames of a roll). A value above .20 will be flagged and reported in the summary report[3].

If the calculate mode is chosen from the average gradient menu then you must ensure that the stepwedge has been supplied with the roll. The next screen prompt is a choice of average gradient calculation which are used; contractors generally use the CSA method. However, it is best to check with the individual companies to verify which methodology was used.

[3] The base and fog value is also used to derive the speed pt.



Upon entering the calculation technique the following screen prompt appears:

BEGIN STEPWEGDE MEASURMENTS s

MEASURE STEP: 21

This prompt requires the use of the densitometer to make the density measurements. As each measurement is made it is displayed on the screen. When all the values for the step-wedge have been measured (21 values) the following screen

display appears:

```
                    BEGIN STEPWEGDE MEASURMENTS

                      MEASURE STEP:  1

          STEP 21 :  0.2600    STEP 14 :  0.8900    STEP  7 :  2.0200
          STEP 20 :  0.2700    STEP 13 :  1.0400    STEP  6 :  2.1500
          STEP 19 :  0.3200    STEP 12 :  1.1900    STEP  5 :  2.2700
          STEP 18 :  0.3900    STEP 11 :  1.3300    STEP  4 :  2.4300
          STEP 17 :  0.4800    STEP 10 :  1.4800    STEP  3 :  2.5700
          STEP 16 :  0.5900    STEP  9 :  1.6700    STEP  2 :  2.7000
          STEP 15 :  0.7300    STEP  8 :  1.8400    STEP  1 :  2.8500
  Average Gradient  :  0.98
      Base and Fog  :  0.24
              EAFS  :  297
   press ENTER to continue?
```

This screen display shows the 21 density measurements taken and shows also the calculated average gradient, effective aerial film speed, and the base + fog.

The next screen prompt is the image sampling routine. The information which is required is displayed below:

```
            Enter the number of frames on this job? 250
            Enter the FIRST frame number: ? 1350
Enter in the number of sample frames (press ENTER for the default of 10)? 10
```

The number of negatives can be obtained from the flight report, while the first negative number is normally displayed on the first frame exposed. The final prompt on this screen requires you to enter the number of negatives which you would like to sample. The default is 10, if this number is not appropriate enter the desired value (1 was entered in the example shown).

The following screen displays the input values previously entered and calculates the interval which will be measured. This interval is a number dependant on the sample size chosen, the total number of frames on the roll, and the numbering system used to identify each negative.

Choose a frame within the given interval which best represents all the frames in that interval; it will be this representative frame which will be used to obtain the density measurements for analysis. Enter this frame number at the appropriate prompt on the screen.

```
Job Number : TEST

Number of frames : 250

Sample number: 1

Measuring interval between frames  1350  and  1375

Enter the negative frame #? 1360
```

On the same screen the next item which appears requests a measurement of 3dmin (minimum density) values.

```
Measure 3 dmin for frame #  1360
                dmin=0.46
                dmin=0.48
                dmin=0.47
```

Using the densitometer measure three areas on the negative frame chosen which transmit the most light (or are lightest). Note that I.C.A.S. specifications require that density measurements are made within a diameter of 10cms. around the fiducial center of the negative. Density measurements should also be made on land detail greater than 5mms. in extent.

The 3 dmins which are measured are used as a small sample to detemine the actual lowest density value on the negative. Only the lowest value of the 3 is chosen in the calculations which follow.

When the minimum density values have been obtained, a prompt for 3dmaxs appears.

```
Measure 3 dmax for frame #  1360
                dmax=1.32
                dmax=1.48
                dmax=1.48
```

Measuring the 3 maximum densities entails the same basic technique as with the minimum densities, in this case specular reflections off terrain objects should be avoided.

This procedure repeats itself for however many frames were stipulated in the sample size. The interval number also adjusts to reflect which batch of negatives should be investigated next.

When the sampling procedure is completed, all the relevant dmins and dmaxs are analyzed by the program to determine:

1. The overall exposure level (from the dmins), and
2. The overall density range (dmaxs-dmins).

These two items are compared with the I.C.A.S. specifications #26 and #27 to provide the status of the roll. The following screen display outlines the data:

AERIAL PHOTOGRAPHY DIAGNOSTICS

Evaluation of job : TEST

The jobs% accept-reject is: ACCEPT 100 % REJECT 0 %

Units found defective are: NONE

I.C.A.S. SPEC. #27 : ***** PASSED *****

I.C.A.S. SPEC. #26 : ***** PASSED *****

E A F S : 297

DMIN AVERAGE : 0.53

DMAX AVERAGE : 1.58

DRNG AVERAGE : 1.05

BASE and FOG IS : 0.2400

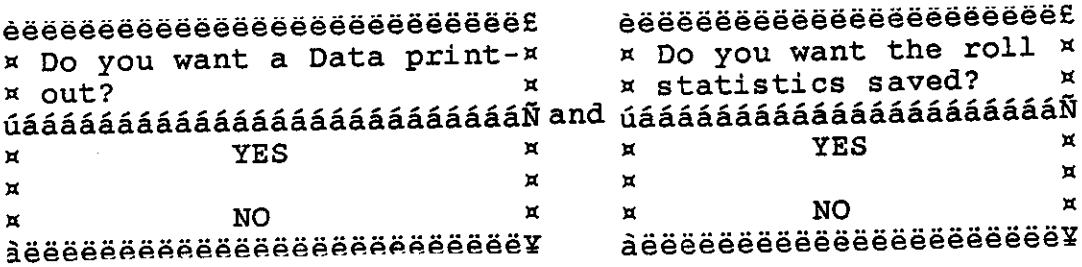
AVERAGE GRADIENT : 0.97

Press RETURN to continue?

As can be seen, a percentage accept/fail figure appears followed by the units or intervals which were found substandard. Specs. #26 and #27 are evaluated and deemed either passed or failed; if failure occurs then the condition is stated.

Finally, some average statistics on the measurements made are displayed.

The next screen prompt request action on a hardcopy of the evaluation; it is followed by a screen prompt requesting a save of the data to a disk file for future reference.



The next screen after the save procedure returns control back to the main menu. At this point another roll can evaluated or the program can be terminated.

Appendix A.

Densitometric Plot sheet sample

SAMPLE OF EVALUATION DATA SHEET

IMAGE DENSITOMETRY DATA

JOB NUMBER: TEST
07-16-1992

FRAME #	DMIN	DMAX	DIFFERENCE		
1360	0.85	1.60	0.75	FAILED SPEC :	26
1385	0.69	1.65	0.96		
1410	0.64	1.11	0.47	FAILED SPEC :	27
1435	0.59	1.46	0.88		
1460	0.37	1.47	1.10	FAILED SPEC :	26
1485	0.50	1.52	1.02		
1510	0.50	1.91	1.41	FAILED SPEC :	27
1535	0.65	1.60	0.95		
1560	0.33	1.44	1.11	FAILED SPEC :	26
1585	0.55	1.51	0.96		
AVERAGE:	0.57	1.53	0.96		

AVERAGE GRADIENT: 1.10

BASE AND FOG: 0.24

CONTRACTOR : ALBERTA GOVERNMENT
I.C.A.S SPEC. #11 : ****** PASSED *****
I.C.A.S. SPEC. #27 : ***** PASSED *****
I.C.A.S. SPEC. #26 : FAILED --- Condition Overexposure
Sampling Percentage accepted is: : 50

Appendix B.

Sensitometer calibration sample sheet

SENSITOMETER CALIBRATION DATA

SENSITOMETER: ALBERTA GOV'T, LAND INFORMATION SERVICES DIVISION
NUMBER: #15

LAMP:
TYPE: DMX 500 WATT CLEAR DATE INSTALLED: 90/02/14

DATE OF COLOR TEMPERATURE (2854K) CALIBRATION: 90/02/15

DATE OF LAST ILLUMINATION CALIBRATION: 90/02/19

OPERATING VOLTAGE (2854 K): 92.05V on Vmeter #FLUKE 8050A

FILM PLANE ILLUMINATION: 165.0 $\ell m/m^2$

TIMER: 166.65 hours

FILTER:
TYPE: GLASS COMBINATION, AERIAL DAYLIGHT #7

DATE INSERTED: 83/12/20

DATE SPECTROPHOTOMETERED: 1982 APPROX. COND: GOOD

SHUTTER CALIBRATION DATE: 90/02/21

EFFECTIVE EXPOSURE TIME: 1/121

PHOTOGRAPHIC STEP TABLET:
NUMBER: 900220 DATE INSTALLED: 90/02/20

STEP:	1	2	3	4	5	6	7	8	9	10	
DENSITY:	0.04	0.20	0.37	0.53	0.67	0.84	0.99	1.15	1.29	1.43	
STEP:	11	12	13	14	15	16	17	18	19	20	21
DENSITY:	1.58	1.73	1.89	2.04	2.19	2.35	2.49	2.64	2.79	2.95	3.10

LOG EXPOSURE AT FILM PLANE:

STEP:	1	2	3	4	5	6	7	8	9	10	
	0.09	$\bar{1}.93$	$\bar{1}.76$	$\bar{1}.60$	$\bar{1}.46$	$\bar{1}.29$	$\bar{1}.14$	$\bar{2}.98$	$\bar{2}.84$	$\bar{2}.70$	
STEP:	11	12	13	14	15	16	17	18	19	20	21
	$\bar{2}.55$	$\bar{2}.40$	$\bar{2}.24$	$\bar{2}.09$	$\bar{3}.94$	$\bar{3}.78$	$\bar{3}.64$	$\bar{3}.49$	$\bar{3}.34$	$\bar{3}.18$	$\bar{3}.03$

Appendix C.

Glossary of terms

Glossary of Terms

Density — This term refers to the optical density of a film material. It is a measure of the opaqueness to light caused by the metallic silverstill present in the gelatine. The density variable is dimesionless since it is a ratio of the light impinging a material and the light transmitted by the material.

Stepwedge — A stepwise increase in density caused by a graded exposure to light On a 21 step greyscale each step represents approximately a 1/2 stop exposure increase.

Base and Fog — The amount of density produced solely from processing (no exposure) a film material is called fog. The base is the density of the support material.

Speed Point — A critical point used to derive film speed. In Aerial photography it is 0.3 density units above the base and fog level.

Film Speed — A variable used to denote the sensitivity of a film to light.

Characteristic Curve — A plot of the densities measured on a 21 step greyscale vs. the exposure values required to produce the densities.

Average Gradient — A measure of the contrast to which the flim was processed. Determined by essentially measuring the slope of thestraight line portion of the characteristic curve.

Appendix D

QC.BAS Program Code

```
DECLARE SUB qcprint ()
DECLARE SUB ImageAnalysis ()
DECLARE SUB POLY (X!(), y!(), c!())
DECLARE FUNCTION Log10! (X!)
DECLARE SUB printwindow (na$, ret$)
DECLARE SUB initialize ()
DECLARE SUB AVEGRAD ()
DECLARE SUB Sampling ()
DECLARE SUB RollEval ()
DECLARE SUB PrintRoutine ()
DECLARE SUB DISKFILE ()
DECLARE SUB CommLines ()
DECLARE SUB constat ()
DECLARE SUB calibration ()
DECLARE SUB conwindow (condata$(), number!, contractor$, connumber!)
DECLARE SUB FindAnswer (y!, X!, c!(), z!)
DECLARE SUB SolveEquation (y!, X!, c!())
DECLARE SUB measure (a!, dr!(), dmin!(), Dmax!())
DECLARE SUB prntdens (a!, dr!(), dmin!(), Dmax!())
DECLARE SUB bbb (i!, b!)
DECLARE SUB Specif (Type$)
DECLARE SUB summary ()
DECLARE SUB LISTING ()
DECLARE SUB EDITCOM ()
DECLARE SUB EDIT2 (matchr$(), con$, asave$)
DIM condata$(20), confile$(20)
DIM grp(30, 3)
DIM dmin(100), Dmax(100), dr(100), frm(100)

CLS
   LOCATE 12, 25
   PRINT "Enter the Program PASSWORD:"
   COLOR 0, 0
   LOCATE 12, 60
   LINE INPUT pass$
   COLOR 7, 0
   SELECT CASE pass$
          CASE "xc"
               LOCATE 15, 25: PRINT "Accessing Program ..."
                  FOR i = 1 TO 5000
                  NEXT i
          CASE IS <> "xc"
               CLS
               LOCATE 10, 25: PRINT "Access Denied ..."
               LOCATE 12, 25: PRINT "Returning to DOS."
                  FOR i = 1 TO 5000
                  NEXT i
               END
   END SELECT
'  ************************************************************
   *              initilization                                 *
   ************************************************************
'  open file number 2 for the windows file

COLOR 15, 0
CLS
'
   enter in the communication port settings from the file "commdata.dat"

   OPEN "commdata.dat" FOR INPUT AS #1
```

```
INPUT #1, commline$
INPUT #1, baudline$
INPUT #1, parityline$
INPUT #1, dataline$
INPUT #1, stopline$
LineStatus$ = commline$ + ":" + baudline$ + "," + paritytline$ + "," + dataline$
CLOSE #1

'  enter in the contractors from the file "contrac.dat"
'
OPEN "contrac.dat" FOR INPUT AS #1
INPUT #1, number
FOR i = 1 TO number
 INPUT #1, condata$(i)
 INPUT #1, confile$(i)
NEXT i
CLOSE #1
OPEN "con" FOR RANDOM AS #2
PRINT #2, "~e=/";
PRINT #2, "~c=all/";
PRINT #2, "~l=qcmenu/"; '   display main menu
start:
returnstring$ = "1"

WHILE returnstring$ <> "5"
   CALL printwindow(returnstring$, "mainmenu")
   PRINT #2, "~c=all/";
   IF returnstring$ = "1" THEN

      CALL initialize      'get initial values
      CALL AVEGRAD         'get the avegradient, either using stepwedge or user i
      CALL ImageAnalysis   'get image motion values
      CALL Sampling        'get the denstometer sample runs of the film
      CALL RollEval        'print out the results onto the screen
      CALL PrintRoutine    'print out the results onto the printer
      CALL DISKFILE        'put the results into a file
   ELSEIF returnstring$ = "2" THEN
      CLS
      CALL CommLines
   ELSEIF returnstring$ = "3" THEN
      CLS
      CALL constat
   ELSEIF returnstring$ = "4" THEN
      CALL calibration
   ELSEIF returnstring$ = "7" THEN
      CALL qcprint
   END IF


WEND
END
STOP
'*******************************************************
' routines used for calibration
'*******************************************************

' ********************* curser up ********************
up2:
    IF pick <> 1 THEN
      pick = pick - 1
```

```
      y = y - 1: X = 55: LOCATE y, X, 1, 0, 7: poss = 1
    END IF
  RETURN
 ********************* curser down ******************
down2:
    IF pick < 21 THEN
       pick = pick + 1
       y = y + 1: X = 55: LOCATE y, X, 1, 0, 7: poss = 1
    END IF
  RETURN
 ********************* left *************************
left2:
   IF X > 55 THEN
     IF X = 61 THEN X = 57
     X = X - 1: LOCATE y, X, 1, 0, 7: poss = poss - 1
   END IF
  RETURN
 ********************* right ************************
right2:
   IF X < 62 THEN
     IF X = 56 THEN X = 60
     X = X + 1: LOCATE y, X, 1, 0, 7: poss = poss + 1
   END IF
  RETURN
 for routine summary
nofile:
   LOCATE 20, 10: PRINT "No file found for this contractor"
   LOCATE 22, 10: INPUT " Press ENTER to continue", aa
   CLOSE #1
   CLS
   RESUME start
up1:
    IF pick <> 1 THEN
      pick = pick - 1
      LOCATE pick + 6, 25: COLOR 7, 0: : PRINT CHR$(186); : PRINT condata$(pick
      LOCATE pick + 5, 25: COLOR 0, 7: PRINT CHR$(186); : PRINT condata$(pick)
    END IF
  RETURN

down1:
    IF pick <> number THEN
       pick = pick + 1
       LOCATE pick + 4, 25: COLOR 7, 0: PRINT CHR$(186); : PRINT condata$(pick
       LOCATE pick + 5, 25: COLOR 0, 7: PRINT CHR$(186); : PRINT condata$(pick)
    END IF
  RETURN
finish:
    finished = 1
  RETURN
nofile2:
        CLS
        PRINT #2, "~w=nofile,nowait/";
        LOCATE 8, 20: PRINT "     look for the files "
        LOCATE 9, 20: PRINT confile$(connumber) + "chr.dat", confile$(connumber
        SHELL "dir *.dat/w"
        LOCATE 24, 20: CALL printwindow(choice$, "recalb")
        IF choice$ = "Y" THEN
           FOR i = 1 TO 21
              matchr$(i) = "     "
           NEXT i
```

```
            CALL EDIT2(matchr$(), condata$(connumber), asave$)
        END IF
        PRINT #2, "~c=all/"; : CLS
        CLOSE #1
        CLOSE #3
 RETURN


' REM $INCLUDE: 'curve.bas'


SUB AVEGRAD
 SHARED AveGradient, LineStatus$, BASEFOG, FilmType$, confile$(), connumber, EA
 DIM X(21), c(10), dn(21)
 CALL printwindow(choice$, "gradmenu")     ' asks if the average gradient will b

 IF choice$ = "1" THEN
    PRINT #2, "~w=gradtxt,nowait/"
    LOCATE 9, 15: INPUT "Average Gradient   : ", AveGradient
    PRINT #2, "~C=last/"
    GOSUB MeasureBaseFog
 ELSE
    CALL printwindow(Type$, "agtype")
    choice$ = "yes"
    GOSUB MeasureBaseFog
    speedpoint = BASEFOG + .3
'   OPEN "com2:300,e,7,1,cs,ds" FOR RANDOM AS #3
    OPEN LineStatus$ + ",cs,ds" FOR RANDOM AS #3
    WHILE choice$ = "yes"
'      OPEN "data6.txt" FOR INPUT AS #3
      LOCATE 11, 20: PRINT "BEGIN STEPWEGDE MEASURMENTS"

      q = 21
      FOR i = 1 TO 21
         LOCATE 13, 20: PRINT "  MEASURE STEP: "; q
         temp$ = INPUT$(5, 3)
        ' IF ERR = 57 THEN PRINT " *** ERROR *** Measure again"
         dn(i) = VAL(RIGHT$(temp$, 4)) * .01
       '  INPUT #3, dn(i)
         IF i < 8 THEN LOCATE i + 14, 10
         IF i > 7 AND i < 15 THEN LOCATE i + 7, 30
         IF i > 14 THEN LOCATE i, 50
         PRINT USING "STEP ## : #.####"; q; dn(i)
         q = q - 1
      NEXT i
      choice$ = "no"
REM      call Printwindow(choice$,"readstep")
    WEND
    CLOSE #3

    ' ------- get the contractors measurements (x-co) --------------------
    a$ = confile$(connumber) + "chr.dat"
    b$ = confile$(connumber) + "mat.dat"
    OPEN a$ FOR INPUT AS #1    ' open the contractor
    OPEN b$ FOR INPUT AS #3    ' file
    INPUT #1, CALDATE$
    FOR q = 1 TO 21
       INPUT #3, mat
       INPUT #1, CHR
       mat = mat / 100
```

```
      X(q) = Log10((10 ^ mat) * (10 ^ CHR))
    NEXT q
    CLOSE #1
    CLOSE #3
    ' --------------  find the average gradient ----------------------
    CALL POLY(X(), dn(), c())          ' find the polynomial that will fit the da
    IF Type$ = "1" THEN
      CALL FindAnswer(speedpoint, AveGradient, c(), PointEafs)' find the Averag
    ELSE

      CALL SolveEquation(speedpoint, PointEafs, c())
      CALL SolveEquation(speedpoint + .3, PointPem, c())
      CALL SolveEquation(speedpoint + 1, point3, c())
      AveGradient = 1 / (point3 - PointEafs)
    END IF
    '------ find EAfs-----------------
    EAFS = 1.5 / 10 ^ PointEafs
    PRINT USING "Average Gradient  : #.##"; AveGradient
    PRINT USING "    Base and Fog  : #.##"; BASEFOG
    PRINT USING "             EAFS  : ###"; EAFS
    INPUT " press ENTER to continue"; aa
  END IF
  EXIT SUB
easureBaseFog:
    PRINT #2, "~w=baftxt,NOWAIT/"
'    OPEN "com2:300,e,7,1,cs,ds" FOR RANDOM AS #3
    OPEN LineStatus$ + ",cs,ds" FOR RANDOM AS #3
      a$ = INPUT$(5, 3)
      IF ERR = 57 THEN PRINT " *** ERROR *** Measure again"
      a2$ = RIGHT$(a$, 4)
    ' INPUT a2$
    BASEFOG = (VAL(a2$)) * .01
    CLOSE #3
    PRINT #2, "~C=last/"
  RETURN
END SUB

UB bbb (i, b)
  SHARED COUNTER, grp()
  IF grp(i, 1) = 0 THEN COUNTER = COUNTER + 1
  grp(i, 1) = i
  IF b = 27 THEN
      grp(i, 2) = 1
  ELSEIF b = 26 THEN
      grp(i, 3) = 1
  END IF
END SUB

UB calibration
' ********* CALABRATION VERFICATION PROCEDURE **********

  SHARED condata$(), number, confile$()
   DIM CHR(21), mat(21), matchr$(21)

   LOCATE 2, 20: PRINT "CALABRATION VERFICATION PROCEDURE"
   LOCATE 3, 20: PRINT "   Please choose a contractor"
   CALL conwindow(condata$(), number, con$, connumber)
   CLS
    ON ERROR GOTO nofile2
   OPEN confile$(connumber) + "chr.dat" FOR INPUT AS #1
```

```
OPEN confile$(connumber) + "mat.dat" FOR INPUT AS #3

INPUT #1, CALDATE$
LOCATE 10, 1: PRINT "Date of last calibration "
PRINT CALDATE$

FOR i = 1 TO 21
   INPUT #1, CHR(i)
   INPUT #3, mat(i)
   a$ = LEFT$(STR$(mat(i)), 4): a$ = RIGHT$(a$, 2)
   b$ = LEFT$(STR$(CHR(i)), 2)
   matchr$(i) = a$ + b$
NEXT i
CLOSE #1
CLOSE #3
CALL EDIT2(matchr$(), condata$(connumber), asave$)
IF asave$ = "y" THEN
    GOTO SaveCalibration
ELSE
    LOCATE 25, 1
    INPUT "Changes NOT saved.  Press ENTER to contuinue"; aa
END IF
CLS
EXIT SUB
SaveCalibration:
    OPEN confile$(connumber) + "chr.dat" FOR OUTPUT AS #1
    OPEN confile$(connumber) + "mat.dat" FOR OUTPUT AS #3
    LOCATE 24, 1: INPUT "Enter installation date (YY/MM/DD):", CALDATE$
    PRINT #1, CALDATE$
    FOR i = 1 TO 21
       a = VAL(RIGHT$(matchr$(i), 2))
       b = INT(VAL(LEFT$(matchr$(i), 2))): bb = b / 100
       PRINT #1, USING "##"; a
       PRINT #3, USING "##"; b
    NEXT i
    CLOSE #1
    CLOSE #3
    LOCATE 24, 1: INPUT "SENSITOMETER RECALIBRATION VALUES COMPLETED (press a
EXIT SUB
END SUB

'*****************************************************************
'               CommLines
SUB CommLines
SHARED LineStatus$, commline$, baudline$, parityline$, dataline$, stopline$
WHILE returnstring$ <> "6"
  CLS
  LOCATE 18, 20
  PRINT "Current setting is: "; LineStatus$
  LOCATE 20, 10: PRINT "communication port = "; commline$
  LOCATE 21, 10: PRINT "baud rate          = "; baudline$
  LOCATE 22, 10: PRINT "parity             = "; parityline$
  LOCATE 23, 10: PRINT "dataline           = "; dataline$
  LOCATE 24, 10: PRINT "stopline           = "; stopline$
  CALL printwindow(returnstring$, "LINEDATA")
  IF returnstring$ = "1" THEN
     CALL printwindow(commline$, "COMM")
  ELSEIF returnstring$ = "2" THEN
     CALL printwindow(baudline$, "BAUD")
  ELSEIF returnstring$ = "3" THEN
```

```
        CALL printwindow(paritylineS, "PARITY")
    ELSEIF returnstring$ = "4" THEN
        CALL printwindow(datalineS, "DATA")
    ELSEIF returnstring$ = "5" THEN
        CALL printwindow(stoplineS, "STOP")
    END IF
    LineStatus$ = commlineS + ":" + baudlineS + "," + paritylineS + "," + datali
    OPEN "commdata.dat" FOR OUTPUT AS #1
    WRITE #1, commlineS, baudlineS, paritylineS, datalineS, stoplineS
    CLOSE #1
    CLS
  WEND
END SUB

*************** Q.C. STATISTICS CONTROL procedure ******************
SUB constat
  SHARED condata$(), confile$(), connumber, number
  DIM RL$(300), FRMNUM(300), accept(300), REJECT(300)
  DIM frmACC(300), FRMREJ(300), s$(300), dmin(300), dr(300), AV(300)

  '***********************   INTRODUCTION   ******************************
  CLS
  WHILE SELCT$ <> "4"
    CALL printwindow(SELCT$, "apmain")
    IF SELCT$ = "1" THEN CALL summary
    IF SELCT$ = "2" THEN CALL LISTING
    IF SELCT$ = "3" THEN CALL EDITCOM
  WEND
END SUB

SUB conwindow (condata$(), number, contractor$, connumber)
   SHARED pick, finished
   ON KEY(11) GOSUB up1
   ON KEY(14) GOSUB down1
   KEY(11) ON
   KEY(14) ON
   pick = 1: COLOR 0, 7
   LOCATE 5, 25
   PRINT CHR$(201);
   FOR i = 1 TO 30
      PRINT CHR$(205);
   NEXT i
   PRINT CHR$(187)
   FOR i = 1 TO number
      LOCATE i + 5, 25: PRINT CHR$(186); : PRINT condata$(i): COLOR 7, 0
   NEXT i
   LOCATE number + 6, 25
   PRINT CHR$(200);
   FOR i = 1 TO 30
     PRINT CHR$(205);
   NEXT i
   PRINT CHR$(188)

   linenumber = 1: finished = 0
   WHILE finished = 0

         choice$ = INKEY$
         IF choice$ <> "" THEN
           IF ASC(choice$) = 13 THEN finished = 1
         END IF
```

```
  WEND
  KEY(11) OFF
  KEY(14) OFF
' KEY(15) OFF
  KEY OFF
  contractor$ = condata$(pick)
  connumber = pick
  COLOR 15, 3

END SUB

'*****************************************************************
'****************** disk file ************************************
SUB DISKFILE
 SHARED jobnumber$, AveGradient, AveDiff, avedmin
 SHARED framenumber, accept, REJECT, confile$(), connumber
  REM
  REM*********************DISK FILE Q.C. DATA*****************************
  REM
  s$ = DATE$
  CLS
  CALL printwindow(EVL$, "rollstat")
  IF EVL$ = "Y" OR EVL$ = "y" THEN
      OPEN confile$(connumber) + "stat.DAT" FOR APPEND AS #1
      WRITE #1, jobnumber$, framenumber, INT(accept), INT(REJECT), AveGradient,
      CLOSE #1
  END IF
END SUB

SUB EDIT2 (matchr$(), con$, asave$)
   ***************************************
   *    subroutine edit2
   * used for the calibration procedure
   * lets you edit the calibration readings
   ***************************************
'  x, y - are the cursor positions
'  poss - is the horizontial positioning
   pick - is the calibration number being edited
   matchr$() - contain the values of the the MAT and CHR
   SHARED X, y, pick, poss, number
   X = 55: y = 3: poss = 1: pick = 1:

' turn the arrow keys on and set the procuderes
' The procedures are in the main program
  COLOR 7, 0
  CLS
  KEY ON
  KEY(12) ON
  KEY(13) ON
  KEY(11) ON
  KEY(14) ON
  ON KEY(11) GOSUB up2
  ON KEY(14) GOSUB down2
  ON KEY(12) GOSUB left2
  ON KEY(13) GOSUB right2

' set up the screen

  LOCATE 1, 55: PRINT "MAT    CHR"
  LOCATE 2, 10: PRINT "Calibration data check"
```

```
LOCATE 4, 1: PRINT "For the contractor "
PRINT con$
LOCATE 12, 1
PRINT "USE THE ARROW KEYS TO "
PRINT "MOVE THE CURSOR AROUND "
PRINT "YOU MAY FREELY EDIT THE DATA "
PRINT ""
PRINT "Press ENTER to exit with changes."
PRINT ""
PRINT "Press ESC to exit without changes."
pick = 1
FOR a = 1 TO 21
    LOCATE a + 2, 40
    PRINT "STEP "; 22 - a;
    LOCATE 2 + a, X: PRINT LEFT$(matchr$(a), 2)
    LOCATE 2 + a, X + 6: PRINT RIGHT$(matchr$(a), 2)
NEXT a
LOCATE y, X, 1, 0, 7

' make a loop which will look for the keys that are pressed
if ENTER is pressed then exit
if ESC is pressed then exit with out updateing the file

WHILE finished = 0
     ' loop until a key is pressed
     DO
       char$ = INKEY$
       IF char$ <> "" THEN char2 = ASC(char$)

     LOOP WHILE char$ = ""
     ' if the key was ENTER then exit and set the save to 'y'
     IF char2 = 13 THEN
        finished = 1
        asave$ = "y"
     ' if the key is ESC then exit and set the save to 'n'
     ELSEIF char2 = 27 THEN
        finished = 1
        asave$ = "n"
     ELSE    ' print the charactor that was pressed
        PRINT char$;
        X = X + 1
        qq$ = LEFT$(matchr$(pick), poss - 1)
        qq2$ = RIGHT$(matchr$(pick), 5 - poss)
        poss = poss + 1
        IF LEN(qq2$) > 0 THEN
          matchr$(pick) = qq$ + char$ + RIGHT$(qq2$, LEN(qq2$) - 1)
        ELSE
          matchr$(pick) = qq$ + char$ + qq2$
        END IF
        IF X = 57 THEN X = 61
        LOCATE y, X, 1, 0, 7
        IF X = 63 AND pick < 21 THEN
            GOSUB down3
        ELSEIF X = 63 AND pick = 21 THEN
            GOSUB left3
        END IF
     END IF
WEND
KEY(11) OFF
KEY(14) OFF
```

```
   KEY(12) OFF
   KEY(13) OFF
   KEY OFF
   LOCATE 20, 10
EXIT SUB
down3:
    ' special down when the x = 63
    IF pick < 21 THEN
       pick = pick + 1
       y = y + 1: X = 55: LOCATE y, X, 1, 0, 7: poss = 1
    END IF
  RETURN
' ********************* left ************************
eft3:
   ' special left when x = 63 and pick = 21
   IF X > 55 THEN
     IF X = 61 THEN X = 57
     X = X - 1: LOCATE y, X, 1, 0, 7: poss = poss - 1
   END IF
  RETURN

ND SUB

UB EDITCOM

 SHARED condata$(), confile$(), number

 WHILE choice$ <> "4"
    CLS
    LOCATE 10, 20: PRINT "Current Contractors"
    FOR i = 1 TO number
      LOCATE 11 + i, 15: PRINT condata$(i)
    NEXT i
    CALL printwindow(choice$, "editmenu")
    CLS
    IF choice$ = "1" THEN GOSUB change
    IF choice$ = "2" THEN GOSUB delete
    IF choice$ = "3" THEN GOSUB add
 WEND
 EXIT SUB
hange:
  LOCATE 2, 5: PRINT " Pick the contractor that is to be altered"
  CALL conwindow(condata$(), number, con$, connumber)
  LOCATE 20, 5: PRINT "Contractor choosen : "; con$
  LOCATE 22, 5: INPUT "Enter in new name of contractor : "; con2$
  LOCATE 23, 5: INPUT "Would you like to start a new file for the contractor (y
  ans2$ = confile$(connumber)
  IF ans$ = "y" OR ans$ = "Y" THEN
    LOCATE 24, 5: INPUT " enter name of file (max 4 characters) "; ans2$
  END IF
  condata$(connumber) = con2$
  confile$(connumber) = ans2$
  CLOSE #1
  GOSUB rewrite
 RETURN

delete:
  z = 1
  LOCATE 2, 5: PRINT " Pick the contractor that is to be deleted"
  CALL conwindow(condata$(), number, con$, connumber)
```

```
  LOCATE 20, 2: PRINT "Verify that :"; con$; : INPUT " is the contactor to be d
  IF ans$ = "y" OR ans$ = "Y" THEN
REM       open "contrac.dat" for output as #1
      FOR i = 1 TO number
         IF i <> connumber THEN
            condata$(z) = condata$(i): confile$(z) = confile$(i)
            z = z + 1
         END IF
      NEXT i
      CLOSE #1
      number = number - 1
      GOSUB rewrite
      LOCATE 22, 2: INPUT "Please confire that the corresponding files will als
      IF confirm$ = "Y" OR confirm$ = "y" THEN
         temp$ = confile$(connumber) + "chr.dat"
         temp$ = "del " + temp$
         SHELL temp$
         temp$ = confile$(connumber) + "mat.dat"
         temp$ = "del " + temp$
         SHELL temp$
         temp$ = confile$(connumber) + "stat.dat"
         temp$ = "del " + temp$
         SHELL temp$
         temp$ = confile$(connumber) + "graf.dat"
         temp$ = "del " + temp$
         SHELL temp$
      END IF
    ELSE
     INPUT " file has not been deleted press return to continue"; aa
    END IF

 RETURN

dd:
   CLS
   LOCATE 2, 10: PRINT "     ADD CONTRACTOR"
   LOCATE 5, 1: INPUT " enter name of contractor to add "; con$
   LOCATE 8, 1
   DO
     INPUT " enter name of contractor file (no longer then 4 characters"; con2$
   LOOP UNTIL LEN(con2$) <= 4
   number = number + 1
   condata$(number) = con$
   confile$(number) = con2$
   GOSUB rewrite
   OPEN con2$ + "chr.dat" FOR OUTPUT AS #1
   OPEN con2$ + "mat.dat" FOR OUTPUT AS #3
   temp = 1
   PRINT #1, date
   FOR i = 1 TO 21
     PRINT #1, temp
     PRINT #3, temp
   NEXT i
   CLOSE #1: CLOSE #3
 RETURN

rewrite:
   OPEN "contrac.dat" FOR OUTPUT AS #1
   PRINT #1, number
   FOR i = 1 TO number
```

```
    WRITE #1, condata$(i)
    WRITE #1, confile$(i)
  NEXT i
  CLOSE #1
 RETURN
END SUB

SUB FindAnswer (y, X, c(), z)
 midd = -1.5: temp1 = -3: temp2 = 1!: diff = 1!:
 CALL SolveEquation(y, z, c())

 WHILE ABS(diff) > .01
   aa = c(1)
'   middlog = log10(midd)
   FOR i = 1 TO 9
     aa = aa * (midd) + c(i + 1)
   NEXT i
   temp = ((aa - y) ^ 2) + ((midd - z) ^ 2)
   temp = temp - 1.5 ^ 2
'   temp = log10(temp)
   diff = temp
   IF temp > .01 AND ABS(diff) > .01 THEN
     middtemp = midd
     midd = midd - (temp2 - temp1) / 2
     temp2 = middtemp
   ELSEIF temp < .01 AND ABS(diff) > .01 THEN
     middtemp = midd
     midd = midd + (temp2 - temp1) / 2
     temp1 = middtemp
   END IF
   IF midd > 4.1 THEN midd = 4.1
 WEND
'   print "y1 is y2 is";aa,y
   print "x1 x2 are ";midd,z
 X = (aa - y) / (midd - z)
END SUB

SUB ImageAnalysis
SHARED imageMotion
 imageMotion = -1
CALL printwindow(choice$, "imagmain")
IF choice$ = "y" THEN
   CLS
   LOCATE 10, 15: INPUT " Enter the average speed of the aircraft (in knots)"; a
   LOCATE 11, 15: INPUT " Enter the slowest shutterspeed used (eg : 200)"; Shutt
   LOCATE 12, 15: INPUT " Enter the scale of the photography (eg : 1000)"; SCALE
   ' calculate the image motion
   temp1 = avespeed * 51.444
   temp2 = temp1 / ShutterSpeed
   temp3 = temp2 / SCALE
   imageMotion = temp3 / .0001
   LOCATE 14, 15: PRINT USING " Image motion has been calculated to be : ###.#";
   LOCATE 15, 15
   IF imageMotion <= 20 THEN
     PRINT " I.C.A.S Specification item #11 is ACCEPTED"
   ELSE
     PRINT " I.C.A.S Specification item #11 is REJECTED"
   END IF
   LOCATE 18, 15: INPUT " press any key to continue"; con
```

```
END IF

END SUB

'*************************************************************************
'              initialize
'*************************************************************************
SUB initialize
    SHARED jobnumber$, FilmType$, LineStatus$, BASEFOG, con$, filmtype2$, condat
    LOCATE 3, 20: PRINT "Please choose the contractor for the job"
    CALL conwindow(condata$(), number, con$, connumber)
    CLS
    PRINT "                                GENERAL INFORMATION"
    PRINT "                                -------------------"
    LOCATE 4, 15: PRINT "Contractor          : "; con$
    PRINT #2, "~w=fieldtxt,NOWAIT/"
    LOCATE 5, 15: INPUT "FIELD JOB NUMBER    : ", jobnumber$
    PRINT #2, "~c=last/"
    CALL printwindow(FilmType$, "filmmenu")
    IF FilmType$ = "1" THEN
        FilmType$ = "Panchromatic"
        CALL printwindow(filmtype2$, "film2")
    ELSE
        FilmType$ = "Infared"
        filmtype2$ = "KODAK I.R."
    END IF
    LOCATE 6, 15: PRINT "FilmType            : "; FilmType$; " : "; filmtype2$

END SUB

SUB LISTING
  SHARED condata$(), number, confile$()
  CLS
  LOCATE 2, 10: PRINT "          Quality control contractor roll listing"
  LOCATE 3, 10: PRINT "                HAVE YOUR PRINTER READY"
  LOCATE 4, 10: PRINT "             Please choose a contractor "
  CALL conwindow(condata$(), number, con$, connumber)
  OPEN confile$(connumber) + "stat.dat" FOR INPUT AS #1
  WIDTH "LPT1:", 255
  LPRINT "QUALITY CONTROL CONTRACTOR ROLL LISTING"
  LPRINT ""
  LPRINT con$
  LPRINT ""
  LPRINT ""
  LPRINT "JOB#     # OF FRAMES    %ACCEPT     %REJECT      AV     DMIN    DRNG   DATE"
  LPRINT "-------------------------------------------------------------------------"
  WHILE NOT EOF(1)
    INPUT #1, RL$, FRMNUM, accept, REJECT, AV, dmin, dr, s$
    LPRINT RL$, ;
    LPRINT USING "###       ###        ###          #.##   #.##    #.##    "; FRMNUM;
    'LPRINT USING "#.##   "; AV;
    'LPRINT USING "#.##   "; DMIN;
    'LPRINT USING "#.##   "; DR;
    LPRINT s$
  WEND
  CLS
  CLOSE 1
END SUB

FUNCTION Log10 (X) STATIC
```

```
   Log10 = LOG(X) / LOG(10#)
END FUNCTION

UB measure (a, dr(), dmin(), Dmax())
  SHARED frm()
  value$ = "dmin": q = 15
  dmin(a) = 2: Dmax(a) = 0          ' this is a temperary variable for Dmin dm
  FOR i = 1 TO 2
    LOCATE q, 20
    PRINT "Measure 3 "; value$; " for frame # "; frm(a)
    FOR j = 1 TO 3
       xa1$ = INPUT$(5, 1)
       xb1$ = RIGHT$(xa1$, 4)
       temp = (VAL(xb1$)) * .01
     '  INPUT #1, temp
       LOCATE q + j, 35
       PRINT value$; "=";
       PRINT USING "#.##"; temp
       IF i = 1 THEN
          IF temp < dmin(a) THEN dmin(a) = temp
       ELSE
          IF temp > Dmax(a) THEN Dmax(a) = temp
       END IF
    NEXT j
    value$ = "dmax": q = 19
  NEXT i
  dr(a) = Dmax(a) - dmin(a)
  INPUT "press enter to continue"; aa

END SUB

UB POLY (X(), y(), c())
DIM d1(50), d2(50), d3(50), d4(50), d5(50), d6(50)
 = 21: m = 9:
OR i = 1 TO n
  s1 = s1 + X(i): s2 = n: s3 = s3 + y(i): s4 = s4 + y(i) * y(i)
EXT i
4(1) = s1 / s2: d5(1) = 0: d6(1) = s3 / s2: d1(1) = 0: d2(1) = 1: vr = s4 - s3

FOR j = 1 TO m
  s1 = 0: s2 = 0: s3 = 0: s4 = 0
  FOR i = 1 TO n
     p1 = 0: p2 = 1
     FOR k = 1 TO j
         p = p2
         p2 = (X(i) - d4(k)) * p2 - d5(k) * p1
         p1 = p
     NEXT k
     p = p2 * p2
     s1 = s1 + p * X(i)
     s2 = s2 + p
     s3 = s3 + p1 * p1
     s4 = s4 + y(i) * p2
  NEXT i
  d4(j + 1) = s1 / s2
  d5(j + 1) = s2 / s3
  d6(j + 1) = s4 / s2
  d3(1) = -d4(j) * d2(1) - d5(j) * d1(1)
  IF j >= 4 THEN
     FOR k = 2 TO j - 2
```

```
      d3(k) = d2(k - 1) - d4(j) * d2(k) - d5(j) * d1(k)
    NEXT k
  END IF
  IF j > 2 THEN
    d3(j - 1) = d2(j - 2) - d4(j) * d2(j - 1) - d5(j)
  END IF
  IF j > 1 THEN
    d3(j) = d2(j - 1) - d4(j)
  END IF
  FOR k = 1 TO j
    d1(k) = d2(k)
    d2(k) = d3(k)
    d6(k) = d6(k) + d3(k) * d6(j + 1)
  NEXT k
NEXT j
FOR j = 1 TO m + 1
  c(j) = d6(m + 2 - j)
NEXT j
p2 = 0
FOR i = 1 TO n
  p = c(1)
  FOR j = 1 TO m
    p = p * X(i) + c(j + 1)
  NEXT j
  p = p - y(i)
  p2 = p2 + p * p
NEXT i


FOR i = 1 TO m + 1
  PRINT "coff "; c(i)
'NEXT i
REM print "residual is :";s2
INPUT "enter TO CONTINUE"; xx
'FOR q = 1 TO 21
'   AveGrad = c(1)
'   FOR i = 1 TO m
'     AveGrad = AveGrad * x(q) + c(i + 1)
'   NEXT i

    PRINT " the answer for "; x(q); "is "; AveGrad
'NEXT q

END SUB

SUB PrintRoutine
  SHARED jobnumber$, grp(), AveGradient, AveDiff, avedmin, avedmax, BASEFOG, Fil
  SHARED frm(), dmin(), Dmax(), dr(), samplenumber, con$, imageMotion, accept
  CLS
  CALL printwindow(cx$, "dataout")
  IF cx$ = "Y" OR cx$ = "y" THEN
    LPRINT "IMAGE DENSITOMETRY DATA"
    LPRINT ""
    LPRINT "JOB NUMBER: "; jobnumber$
    LPRINT DATE$
    LPRINT "-------------------------------------------------------"
    LPRINT "FRAME #    DMIN     DMAX     DIFFERENCE"
    LPRINT "-------------------------------------------------------"
    FOR i = 1 TO samplenumber
```

```
      LPRINT USING "#####       #.##      #.##      #.##       "; frm(i); dmin(i);
      IF grp(i, 1) > 0 THEN
        LPRINT "FAILED  SPEC : ";
        IF grp(i, 2) = 1 THEN LPRINT "  27 ";
        IF grp(i, 3) = 1 THEN
          LPRINT "  26 "
        ELSE
          LPRINT
        END IF
      ELSE
        LPRINT
      END IF
    NEXT i
    LPRINT "-------------------------------------------------------------"
    LPRINT USING "AVERAGE:    #.##      #.##      #.##"; avedmin; avedmax; AveDiff
    LPRINT
    LPRINT USING "AVERAGE GRADIENT:   #.##"; AveGradient
    LPRINT
    LPRINT USING "BASE AND FOG:       #.####"; BASEFOG
    LPRINT
    LPRINT "CONTRACTOR : "; con$
    IF imageMotion <> -1 THEN
      IF imageMotion <= 20 THEN
        LPRINT "I.C.A.S SPEC. #11 :   ****** PASSED *****"
      ELSE
        LPRINT "I.C.A.S SPEC. #11 :   ****** FAILED *****"
      END IF
    END IF
  END IF
  LPRINT "Sampling Percentage accepted is: :"; accept
  CLOSE #1
  CALL Specif("p")
END SUB

UB printwindow (na$, ret$)
  PRINT #2, "~w="; ret$; "/"
  LOCATE 1, 1
  LINE INPUT na$
  LOCATE 1, 1: PRINT "                                    "
END SUB

UB prntdens (a, dr(), dmin(), Dmax())
    SHARED frm()
    value$ = "dmin": q = 15
    dmin(a) = 2: Dmax(a) = 0            ' this is a temperary variable for Dmin dm
    FOR i = 1 TO 2
      LOCATE q, 20
      PRINT "Measure 3 "; value$; " for frame # "; frm(a)
      FOR j = 1 TO 3
         xa1$ = INPUT$(6, 1)
         xb1$ = MID$(xa1$, 2, 4)
         temp = (VAL(xb1$)) * .001
       '  INPUT #1, temp
         LOCATE q + j, 35
         PRINT value$; "=";
         PRINT USING "#.##"; temp
         IF i = 1 THEN
            IF temp < dmin(a) THEN dmin(a) = temp
         ELSE
            IF temp > Dmax(a) THEN Dmax(a) = temp
```

```
      END IF
    NEXT j
    value$ = "dmax": q = 19
  NEXT i
  dr(a) = Dmax(a) - dmin(a)
  INPUT "press enter to continue"; aa

END SUB

SUB qcprint
  CLS
  SHARED dr(), dmin(), Dmax(), COUNTER, grp(), AveDiff, avedmax, avedmin, AveGra
  SHARED LineStatus$, BASEFOG, samplenumber, jobnumber$, framenumber, frm(), ret
  DIM num(100)


  COUNTER = 0
  accept = REJECT = 0
  LOCATE 12, 1: INPUT "Enter in the number of sample frames (press ENTER for the
  IF samplenumber = 0 THEN samplenumber = 10
  CLS
     CALL printwindow(returnstring$, "qcprnt")

  CLS
  OPEN LineStatus$ + ",cs,ds" FOR RANDOM AS #1
  FOR i = 1 TO samplenumber
     CLS
     LOCATE 3, 20: PRINT "Job Number :"; jobnumber$
     LOCATE 6, 20
     PRINT "Total of prints :"; samplenumber
     LOCATE 8, 20
     PRINT "Sample print number:"; i
     LOCATE 12, 10
     INPUT "Enter the print frame #"; frm(i)
       IF returnstring$ = "4" THEN
          CALL measure(i, dr(), dmin(), Dmax())
       ELSE
          CALL prntdens(i, dr(), dmin(), Dmax())
       END IF
   NEXT i
   INPUT "Finished sample evaluation press any key to continue", continue
   CLOSE #1

   CLS
   LOCATE 1, 20: PRINT "Print/Diapositive Densitometric Summary"
   LOCATE 3, 20: PRINT "* indicates the value is substandard"
   IF returnstring$ = "1" THEN
      FOR i = 1 TO samplenumber
          LOCATE 5, 10: PRINT "Print Frame #    Dmin              Dmax              Dra
          IF dmin(i) < .2 THEN
                testdmin$ = "*Low*"
          ELSEIF dmin(i) > .6 THEN
                testdmin$ = "*High*"
          ELSE testdmin$ = "OK"
          END IF
          IF Dmax(i) < 1 THEN
                testdmax$ = "*Low*"
          ELSEIF Dmax(i) > 1.4 THEN
                testdmax$ = "*High*"
          ELSE testdmax$ = "OK"
```

```
        END IF
        IF dr(i) < .85 THEN
              testdr$ = "*Low*"
        ELSEIF dr(i) > 1.35 THEN
              testdr$ = "*High*"
        ELSE testdmax$ = "OK"
        END IF
        LOCATE i + 7, 10: PRINT frm(i), , dmin(i); testdmin$, Dmax(i); testdma
    NEXT i
ELSEIF returnstring$ = "2" THEN
FOR i = 1 TO samplenumber
        LOCATE 5, 10: PRINT "Print Frame #    Dmin              Dmax              Dra
        IF dmin(i) < .2 THEN
              testdmin$ = "*Low*"
        ELSEIF dmin(i) > .4 THEN
              testdmin$ = "*High*"
        ELSE testdmin$ = "OK"
        END IF
        IF Dmax(i) < 1.05 THEN
              testdmax$ = "*Low*"
        ELSEIF Dmax(i) > 1.35 THEN
              testdmax$ = "*High*"
        ELSE testdmax$ = "OK"
        END IF
        IF dr(i) < .7 THEN
              testdr$ = "*Low*"
        ELSEIF dr(i) > 1.1 THEN
              testdr$ = "*High*"
        ELSE testdmax$ = "OK"
        END IF
        LOCATE i + 7, 10: PRINT frm(i), , dmin(i); testdmin$, Dmax(i); testdma
    NEXT i
 ELSEIF returnstring$ = "3" THEN
    FOR i = 1 TO samplenumber
        LOCATE 5, 10: PRINT "Print Frame #    Dmin              Dmax              Dra
        IF dmin(i) < .1 THEN
              testdmin$ = "*Low*"
        ELSEIF dmin(i) > .3 THEN
              testdmin$ = "*High*"
        ELSE testdmin$ = "OK"
        END IF
        IF Dmax(i) < 1.2 THEN
              testdmax$ = "*Low*"
        ELSEIF Dmax(i) > 1.4 THEN
              testdmax$ = "*High*"
        ELSE testdmax$ = "OK"
        END IF
        IF dr(i) < 1.1 THEN
              testdr$ = "*Low*"
        ELSEIF dr(i) > 1.3 THEN
              testdr$ = "*High*"
        ELSE testdmax$ = "OK"
        END IF
        LOCATE i + 7, 10: PRINT frm(i), , dmin(i); testdmin$, Dmax(i); testdma
    NEXT i
 ELSEIF returnstring$ = "4" THEN
    FOR i = 1 TO samplenumber
        LOCATE 5, 10: PRINT "Print Frame #    Dmin              Dmax              Dra
        IF dmin(i) < .3 THEN
              testdmin$ = "*Low*"
```

```
         ELSEIF dmin(i) > .4 THEN
              testdmin$ = "*High*"
         ELSE testdmin$ = "OK"
         END IF
         IF Dmax(i) < .95 THEN
              testdmax$ = "*Low*"
         ELSEIF Dmax(i) > 1.1 THEN
              testdmax$ = "*High*"
         ELSE testdmax$ = "OK"
         END IF
         IF dr(i) < .65 THEN
              testdr$ = "*Low*"
         ELSEIF dr(i) > .7 THEN
              testdr$ = "*High*"
         ELSE testdr$ = "OK"
         END IF
         LOCATE i + 7, 20: PRINT frm(i), dmin(i); testdmin$, Dmax(i); testdmax$
    NEXT i
END IF
CLOSE #1
LOCATE 23, 10: PRINT "Press enter to continue";
INPUT c

CLS
LOCATE 10, 20: PRINT "Do you want a printout? (Enter Y(es) or N(o))"
INPUT q$
IF q$ = "Y" OR q$ = "y" THEN GOTO printout
IF q$ = "N" OR q$ = "n" THEN GOTO done


printout:
  LPRINT jobnumber$
  LPRINT "Print/Diapositive Densitometric Summary"
  LPRINT ""
  LPRINT "Print Frame #    Dmin            Dmax            Drange "
IF returnstring$ = "1" THEN
    FOR i = 1 TO samplenumber
        IF dmin(i) < .2 OR dmin(i) > .6 THEN testdmin$ = "*"
        IF Dmax(i) < 1 OR Dmax(i) > 1.4 THEN testdmax$ = "*"
        IF dr(i) < .85 OR dr(i) > 1.35 THEN testdr$ = "*"
        LPRINT frm(i), , dmin(i); testdmin$, Dmax(i); testdmax$, dr(i); testdr
    NEXT i
ELSEIF returnstring$ = "2" THEN
FOR i = 1 TO samplenumber
        IF dmin(i) < .2 OR dmin(i) > .4 THEN testdmin$ = "*"
        IF Dmax(i) < 1.05 OR Dmax(i) > 1.35 THEN testdmax$ = "*"
        IF dr(i) < .7 OR dr(i) > 1.1 THEN testdr$ = "*"
        LPRINT frm(i), , dmin(i); testdmin$, Dmax(i); testdmax$, dr(i); testdr
    NEXT i
 ELSEIF returnstring$ = "3" THEN
    FOR i = 1 TO samplenumber
        IF dmin < .1 OR dmin > .3 THEN testdmin$ = "*"
        IF Dmax < 1.2 OR Dmax > 1.4 THEN testdmax$ = "*"
        IF dr < 1.1 OR dr > 1.3 THEN testdr$ = "*"
        LPRINT frm(i), , dmin(i); testdmin$, Dmax(i); testdmax$, dr(i); testdr
    NEXT i
 ELSEIF returnstring$ = "4" THEN
    FOR i = 1 TO samplenumber
        IF dmin(i) < .3 OR dmin(i) > .4 THEN testdmin$ = "*"
```

```
        IF Dmax(i) < .95 OR Dmax(i) > 1.1 THEN testdmax$ = "*"
        IF dr(i) < .65 OR dr(i) > .7 THEN testdr$ = "*"
        LPRINT frm(i), , dmin(i); testdmin$, Dmax(i); testdmax$, dr(i); testdr
     NEXT i
  END IF

one:
LS
END SUB

'*****************************************************************
'***                        roll Eval                          ***
SUB RollEval
  SHARED jobnumber$, grp(), AveGradient, AveDiff, avedmin, avedmax, BASEFOG, Fi
  SHARED accept, REJECT, COUNTER, samplenumber, EAFS
  CLS
  LOCATE 2, 25: PRINT "AERIAL PHOTOGRAPHY DIAGNOSTICS"
  LOCATE 4, 9: PRINT "Evaluation of job : "; jobnumber$
  LOCATE 6, 9: PRINT "The jobs% accept-reject is:"
  REJECT = (COUNTER / samplenumber) * 100
  accept = 100 - REJECT
  LOCATE 6, 40: PRINT USING "ACCEPT ### %  REJECT ### %"; accept; REJECT

  LOCATE 8, 9: PRINT "Units found defective are: ";
  IF COUNTER > 0 THEN
     temp = 0
     FOR i = 1 TO samplenumber
        IF grp(i, 1) > 0 THEN
          LOCATE 8, 40 + 2 * temp
          temp = temp + 1
          PRINT i
        END IF
     NEXT i
   ELSE
     PRINT "NONE"
  END IF
  CALL Specif("S")

  LOCATE 14, 9
  PRINT USING "E A F S            :    ###"; EAFS
  LOCATE 16, 9
  PRINT USING "DMIN AVERAGE       :   #.##"; avedmin
  LOCATE 18, 9
  PRINT USING "DMAX AVERAGE       :   #.##"; avedmax
  LOCATE 20, 9
  PRINT USING "DRNG AVERAGE       :   #.##"; AveDiff
  LOCATE 22, 9
  PRINT USING "BASE and FOG IS    :   #.####"; BASEFOG
  LOCATE 24, 9
  PRINT USING "AVERAGE GRADIENT   :   #.##"; AveGradient
  LOCATE 25, 20
  INPUT "Press RETURN to continue"; jx$
END SUB

'*****************************************************************
'****                  sampling                       ******************
SUB Sampling
  SHARED dr(), dmin(), Dmax(), COUNTER, grp(), AveDiff, avedmax, avedmin, AveGra
  SHARED LineStatus$, BASEFOG, samplenumber, jobnumber$, framenumber, frm()
  DIM num(100)
```

```
CLS
COUNTER = 0
accept = REJECT = 0
LOCATE 10, 15: INPUT "Enter the number of frames on this job"; framenumber
LOCATE 11, 15: INPUT "Enter the FIRST frame number:"; num(1)
LOCATE 12, 1: INPUT "Enter in the number of sample frames (press ENTER for the
IF samplenumber = 0 THEN samplenumber = 10
inter = INT(framenumber / samplenumber)
CLS
OPEN LineStatus$ + ",cs,ds" FOR RANDOM AS #1
FOR i = 1 TO samplenumber
   CLS
   num(i + 1) = num(i) + inter
   LOCATE 3, 20: PRINT "Job Number :"; jobnumber$
   LOCATE 6, 20
   PRINT "Number of frames :"; framenumber
   LOCATE 8, 20
   PRINT "Sample number:"; i
   LOCATE 10, 10
   PRINT , "Measuring interval between frames "; num(i); " and "; num(i + 1)
   LOCATE 12, 10
   INPUT "Enter the negative frame #"; frm(i)
   CALL measure(i, dr(), dmin(), Dmax())

   grp(i, 1) = 0: grp(i, 2) = 0: grp(i, 3) = 0
   IF dr(i) < .7 AND AveGradient < 1.3 THEN
         CALL bbb(i, 27)
   ELSEIF dr(i) > 1.4 AND AveGradient > 1 THEN
         CALL bbb(i, 27)
   END IF
   IF FilmType$ = "2" THEN
      IF Dmax(i) < 1.1 OR Dmax(i) > 1.4 THEN
         CALL bbb(i, 26)
      END IF
   ELSEIF dmin(i) < (BASEFOG + .2) OR dmin(i) > (BASEFOG + .6) THEN
         CALL bbb(i, 26)
   ELSEIF Dmax(i) > 2 THEN
         CALL bbb(i, 26)
   END IF

   SumDmin = SumDmin + dmin(i)
   SumDmax = SumDmax + Dmax(i)
 NEXT i
 avedmax = SumDmax / samplenumber
 avedmin = SumDmin / samplenumber
 AveDiff = (SumDmax / samplenumber) - (SumDmin / samplenumber)
 INPUT "Finished sample evaluation press any key to continue", continue
 CLOSE #1

END SUB

UB SolveEquation (y, X, c())

 midd = -1.5: temp1 = -3: temp2 = 0: diff = 1!
 WHILE ABS(diff) > .01
   temp = c(1)
   FOR i = 1 TO 9
     temp = temp * (midd) + c(i + 1)
   NEXT i
   diff = y - temp
```

```
    IF temp > y AND ABS(diff) > .01 THEN
      middtemp = midd
      midd = midd - (temp2 - temp1) / 2
      temp2 = middtemp
    ELSEIF temp < y AND ABS(diff) > .01 THEN
      middtemp = midd
      midd = midd + (temp2 - temp1) / 2
      temp1 = middtemp
    END IF
    IF midd > 1! THEN midd = 1!
  WEND
  X = midd

END SUB

SUB Specif (Type$)
  SHARED AveDiff, AveGradient, FilmType$, BASEFOG, avedmin, avedmax

  IF Type$ = "p" THEN
      OPEN "scrn:" FOR OUTPUT AS #1
  END IF
  LOCATE 10, 9: LPRINT , "I.C.A.S. SPEC. #27 : ";

  IF AveDiff < .7 AND AveGradient < 1.3 THEN
     LPRINT , " FAILED ---  A.G. low for terrain contrast"
  ELSEIF AveDiff > 1.4 AND AveGradient > 1 THEN
     LPRINT , " FAILED ---  A.G. high for terrain contrast"
  ELSE
     LPRINT , " ***** PASSED *****"
  END IF
  IF FilmType$ = "infrared" THEN
      LOCATE 12, 9
      IF avedmax < 1.1 THEN
         LPRINT , "I.R Low Density     : FAILED --- Condition  Underexposure"
      ELSEIF avedmax > 1.4 THEN
         LPRINT , "I.R High Density    : FAILED --- Condition  Overexposure"
      ELSE
         LPRINT , "I.R. Exposure       : **** PASSED ****"
      END IF
  ELSE
      Dminu = BASEFOG + .6
      Dminl = BASEFOG + .2
      LOCATE 12, 9
      LPRINT , "I.C.A.S. SPEC. #26 :";
      IF avedmin < Dminl THEN
         LPRINT , " FAILED ---  Condition   Underexposure "
      ELSEIF avedmin > Dminu THEN
         LPRINT , " FAILED ---  Condition   Overexposure"
      ELSE
         LPRINT , " ***** PASSED *****"
      END IF
  END IF
  CLOSE 1
END SUB

'**************************Q.C. CONTRACTOR SUMMARIES***************
SUB summary
  SHARED condata$(), confile$(), connumber, number
  LOCATE 2, 20: PRINT "Q.C. CONTRACTOR SUMMARIES"
  LOCATE 3, 20: PRINT "please choose a contractor"
```

```
CALL conwindow(condata$(), number, con$, connumber)
COLOR 7, 0: CLS
ON ERROR GOTO nofile
OPEN confile$(connumber) + "stat.dat" FOR INPUT AS #1
TOTACC = 0
TOTREJ = 0
WHILE NOT EOF(1)
   INPUT #1, RL$, FRMNUM, accept, REJECT, AV, dmin, dr, s
   frmACC = FRMNUM * (accept / 100)
   FRMREJ = FRMNUM * (REJECT / 100)
   TOTACC = TOTACC + frmACC
   TOTREJ = TOTREJ + FRMREJ
   i = i + 1
WEND

CLOSE 1
pcentacpt = (TOTACC / (TOTACC + TOTREJ)) * 100
pcentrejt = (TOTREJ / (TOTACC + TOTREJ)) * 100
LOCATE 5, 20
PRINT "QUALITY CONTROL CONTRACTOR SUMMARY REPORT"
LOCATE 7, 25
PRINT "For :"; con$
LOCATE 10, 10
PRINT "The number of roll evaluations to date is:"; i
LOCATE 12, 10
PRINT USING "The percentage of photography accepted to date is  ###.#"; pcenta
LOCATE 14, 10
PRINT USING "The percentage of photography rejected to date is  ###.#"; pcentr
LOCATE 23, 20
INPUT "Enter RETURN to continue", aa
CLOSE 1
CLS
END SUB
```